presa más frecuente que se identificó en las egagrópilas es *Tylomys nudicaudus,* una rata grande semiarbórea. Otras presas incluyen insectos de diferentes tamaños, mamíferos medianos y pequeños (incluyendo un murciélago), aves medianas y probablemente crustáceos. La presa principal probablemente es demasiado grande para que se alimenten de ella los otros búhos que se encuentran en la mayor parte del área de distribución del Búho Gorjiblanco.

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NOTES ON A NEST OF THE TAWNY FISH-OWL (*KETUPA FLAVIPES*) AT SAKATANG STREAM, TAIWAN

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Fish-owls are often regarded as the nocturnal counterparts of Ospreys (*Pandion haliaetus*), fish-eagles (*Ichthyophaga* spp.) and sea-eagles (*Haliaeetus* spp.). There are four species in the Asian genus *Ketupa* and three species in the African genus *Scotopelia* (Fogden 1973). Of the Asian species, we know the least about the Tawny Fish-Owl (*Ketupa flavipes*). Kou (1986) reported one instance of mating on Taiwan and Voous (1988) described nest locations and clutch sizes in India. Herein, we document the diet of a pair of Tawny Fish-Owls and attempt to dem-

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onstrate how availability of amphibian prey species affects the composition of the diet on Taiwan.

STUDY AREA AND METHODS

We conducted our study from January–December 1994 at Sakatang Stream on the eastern side of Taiwan, 90 km south of Taipei. The area consists of a gorge with bluffs and hills ranging up to 2400 m elevation, with tropical rainforest vegetation dominated by *Ficus* and Lauraceae along streams (Taiwan Forestry Bureau 1995). A few aboriginal villages are scattered throughout the area (Hsu 1984).

We monitored breeding behavior at the nest from 23 March–15 May 1994. To evaluate selection of prey, we identified the numbers and types of prey that the pair of Tawny Fish-Owls brought to their nest. The nest was monitored using three automatic cameras at the nest and a blind 20 m away. We kept separate observations on prey delivered by each of the adults because we could easily distinguish the male by the white patch on the top of its head. Observations on the female ended on 8 May when she was trapped and instrumented with a radiotransmitter. Observations on the male ended on 15 May when it was killed by an indigenous hunter. Subsequently, we took the owlet to an aviary on the Taiwan Normal University campus in Taipei.

To evaluate selection of amphibian prey, we used the percent of the total of each prey species that was brought to the nest as an index of prey use. We used the numbers of individuals of each prey species seen per hr within 3 m of either side of 5 transects measuring a total of 1 km as an index of prey availability. We calculated indices for each stream habitat type along Sakatang Stream using over five nights from 16 April–10 May 1994. Counts along transects were usually finished within 1 hr, but were always completed within 3 hr after dark on nights with little or no rain (<5 mm).

To estimate the overall abundance of a given amphibian along Sakatang Stream, we multiplied the prey availability index for each habitat type by the percent of the total stream habitat that it comprised. Percentages of each habitat type were calculated using 5-km stream sections and establishing imaginary perpendicular lines across the stream every 10 m. Along each line, we recorded habitat type directly under the transect at 1 m intervals. The percent total of the points in each habitat type was calculated as the ratio of area of each habitat type for the 5-km stream section. Stream habitat types included: (1) low-gradient riffle, current <0.5 m/sec, with rocks above water surface <5 m apart; (2) high-gradient riffle, current >0.5 m/sec, with rocks above water surface <5 m apart; (3) run, current >0.5 m/sec, with rocks above water surface >5 m apart; and (4) pool, current <0.5 m/sec, water >30 cm in depth, with rocks above water surface >5 m apart.

We used a Chi-square Contingency Table (Neu et al. 1974, Conover 1980) to test for associations between food delivery rates, sex of the adult owl and age of the nestling to determine prey selection. Data were managed and analyzed with the Statistical Analysis System (SAS Institute 1989).

RESULTS AND DISCUSSION

We flushed a Tawny Fish-Owl from the Sakatang Stream bed while searching for owl pellets in January 1994. On 7 March, a fish-owl, later identified as the male, flew into a riparian forest near where we found an occupied nest on 23 March. The nest was on top of an epiphytic bird's nest fern (*Pseudorynaria coronans*) on a big large-leafed Nanmu tree (*Machilus kusanoi*), about 80 cm in dbh and about 70 m from the stream. Indigenous hunters indicated that they had previously seen two other owl nests in these ferns. Gerhardt et al. (1994) reported that the neotropical Black-and-white Owl (*Strix nigrolineata*) would nest in the epiphytic orchid *Trigonidium egertonianum* in large, live trees. The bird's nest fern also occurs in southern China, Burma, Nepal and Malaya within the distribution of other Asian fish-owls (except for Blakiston's Fish-Owl, *Ketupa blakistoni*). Nevertheless, these species do not use bird's nest fern but instead nest in tree cavities, holes in river banks, caves on cliffs, forks of trees and abandoned nests of fish-eagles (Fogden 1973, Voous 1988).

The nest was 10 m above ground and contained one white egg in a shallow unlined depression. To reduce disturbance, we did not visit the nest again until 14 April when we found a 2–3-wk-old downy owlet in the nest. It weighed 650 g, or about 24–32% of an adult fish-owl's weight (2050–2650 g). Subsequent observations indicated that the female brooded the young for several hours at a time during daylight hours. Brooding stopped on 20 April.

The adults often duetted in the vicinity of the nest 0.5–1 hr prior to onset of foraging. Most duets began prior to sunset and lasted 23–70 min, but duets were also sometimes heard during the hr before sunrise. The female gave a mewing "hew" and the male a deep "who-hoo" call. The nestling's begging calls, "whe," resembled that of the female's mewing, but at a lower pitch, and were given at night in response to the calling parents.

Food deliveries to the nest occurred exclusively at night. Here, too, deliveries coincided with sunrise and sunset, occurring more frequently 1 hr after dark and before daybreak. Southern owl populations usually show this bimodal feeding periodicity in contrast to the unimodal pattern of their northern conspecifics (Mikkola 1983). Gehlbach (1994) suggested that in cold regions with shorter nights and lower prey densities owls will forage intensively at night and are forced to hunt by day.

Based on 80 photographs made of the adults delivering prey to the nest (Table 1), each parent's contribution to the total food supplied to the nest did not change during the nesting season ($\chi^2 = 3.70$, df = 2, $P = 0.16$). Nevertheless, there was a tendency for the female to deliver more food items during the postbrooding stage, whereas the male provided all of the food when the young owl was only 1-wk old.

Amphibians, followed by fish, comprised the bulk

Table 1. Number (percent) of feeding trips made by a nesting female and male Tawny Fish-Owl from April–May 1994.

NESTLING STAGE	FEMALE	MALE
Brooding (14–20 d)	6 (40.0)	9 (60.0)
Early postbrooding (21–28 d)	14 (58.3)	10 (41.7)
Late postbreeding (29–35 d)	28 (68.3)	13 (31.7)

Table 2. Number (percent) of prey items delivered by a female and male Tawny Fish-Owl to their nest from April–May 1994.

PREY	FEMALE	MALE
Brown tree frog (*Buergeria robusta*) and tip-nosed frog (*Rana naria swinhosana*)	10 (47.6)	6 (28.5)
Taiwan common toad (*Bufo bufo gargarizans*)	3 (14.3)	8 (38.1)
Unidentified amphibians	5 (23.8)	2 (9.5)
Fish (*Varicorhinus barbatulus*)	3 (14.3)	2 (9.5)
Spinous country-rat (*Niviventer coxinga*)	0	1 (4.8)
Freshwater crabs (*Candioptamon* spp.)	0	1 (4.8)
Freshwater shrimps (*Macrobrachium* spp.)	0	1 (4.8)

(>75%) of the prey deliveries (Table 2). Of the amphibians, 11 toads (*Bufo bufo gargarizans*) were delivered more frequently than expected based on their estimated availability (96 toads/km, Bonferroni, $P < 0.05$). We estimated that there were 291 brown tree (*Buergeria robusta*) and tip-nosed frogs (*Rana naria swinhosana*) available along our 1 km transects, but only 16 were observed to be delivered to the nest. As the nestling grew, the adults increased the frequency of their food deliveries, nearly doubling their deliveries during the postbrooding period ($\chi^2 = 10.6$, df = 2, $P = 0.005$). Thereafter, deliveries declined. In addition, the proportion of larger prey items such as toads increased in the late postbrooding period.

Other than an amphibian leg bone or passerine feather, we rarely found prey remains or pellets in the nest. However, two female toads were left in the nest twice in late April, indicating that the owlet was sensitive to their toxic glands.

RESUMEN.—Nosotros observamos un nido de le *Ketupa flavipes* para documentar su conducta de cría y sus costumbres de comer durante el tiempo de cría. Un huevo singular fue ponido en el nido. La hembra aparentemente hizo toda la incubación. El par canto mas antes la puesta del sol y a la salida del sol y cantando coincidio con actividad de forraje. Un total de 80 entregas de presa fueron fotograficados en el nido. El macho entrego mas presa cuando empezo el tiempo de poner, pero la hembra entrego presa durante el ultimo parte del tiempo de poner. La presa consistió de *Bufo bufo gargarizans* que aparentemente no fueron tomados en su proporción de disponibilidad. La frecuencia y el tamaño de la presa entregada para el nido aumento durante el tiempo de poner.

[Traducción de Raúl De La Garza, Jr.]

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